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Title: I have beam time, what's next?

Author(s): George, Jeffrey Spencer

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“I have beam time, what’s next?”

2019 LANL Radiation Effects Summer School



Jeff George

July 18, 2019



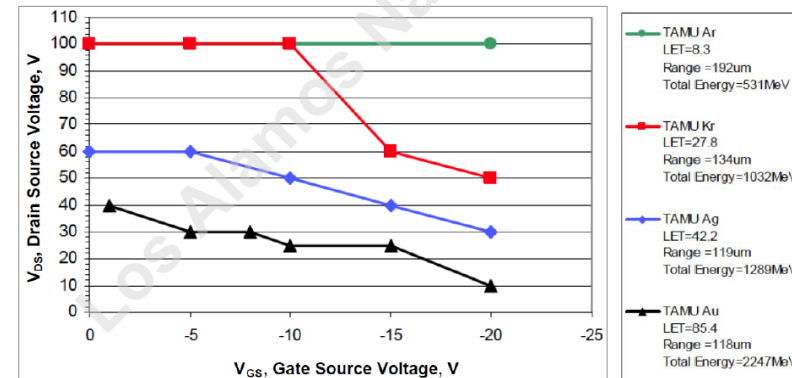
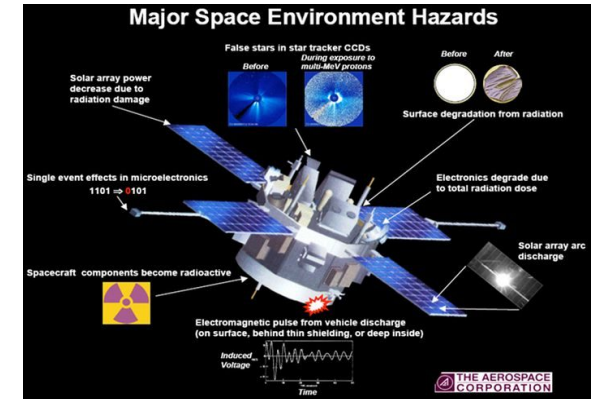
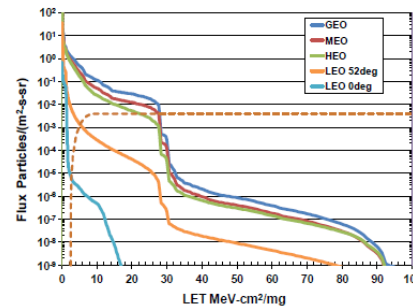
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“Go test this part”

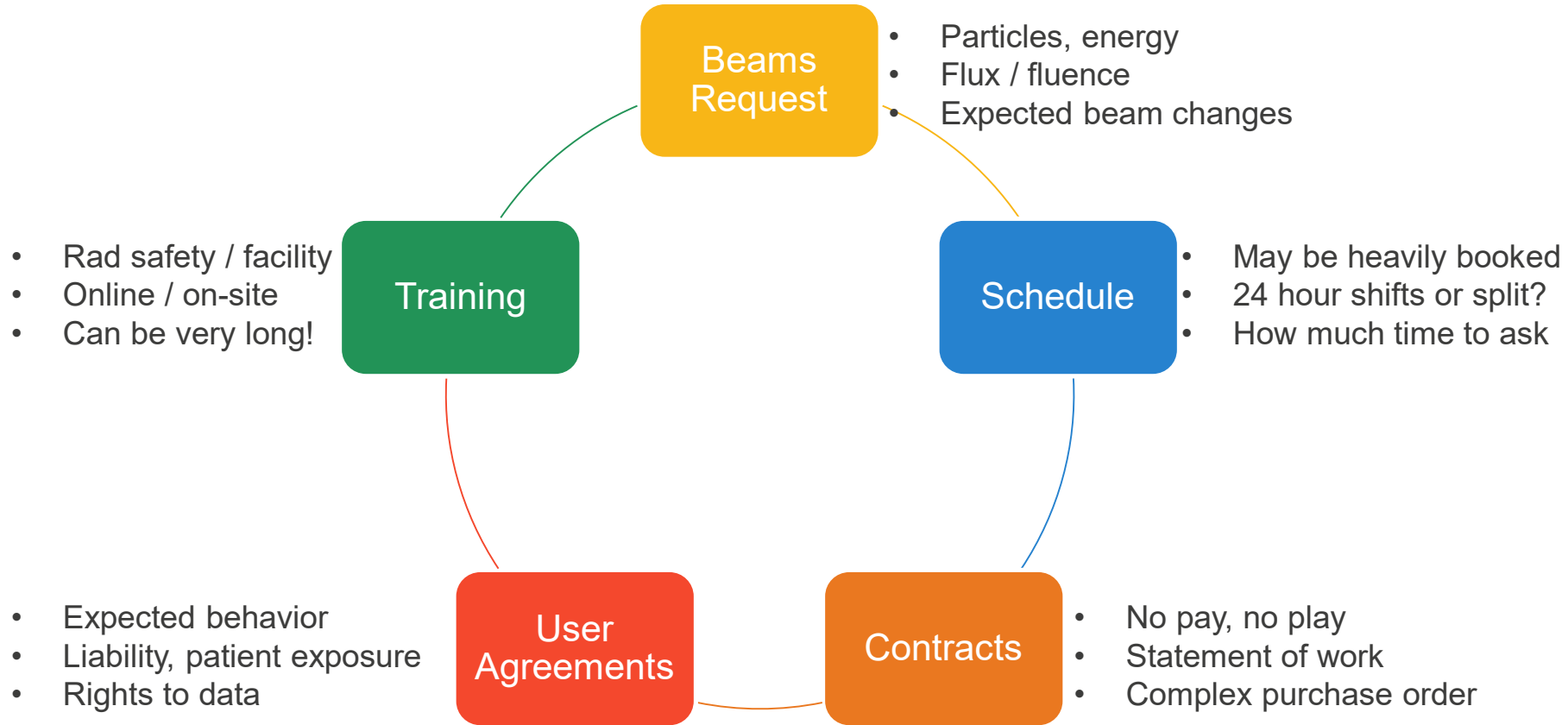
- Radiation effects testing typically doesn't drive the design process
 - Few organizations have dedicated radiation effects staff
 - Often trying to prove what is already designed will work
 - A box to check off to satisfy contractual requirements
- SURPRISE!!!
 - It's now your job and we need the data last week
- What do you do now?

What kind of test do I need?

- What is the concern?
 - Single event effects, total ionizing dose, displacement damage
 - Materials degradation
- What is the threat?
 - Expected environment
 - Protons, ions, neutrons...
- What is the goal?
 - Verification or characterization
 - Ensure safe operation or predict failure rate
- Now select the type of facility



Facility arrangements



Beam Schedule

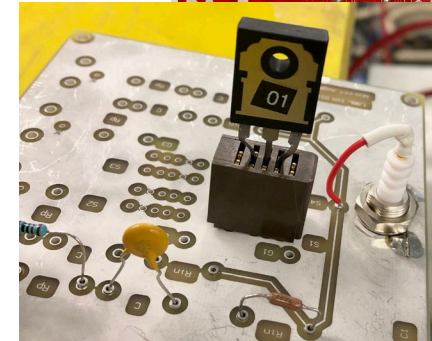
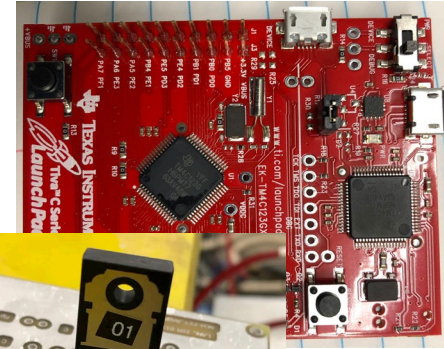
- Texas A&M cyclotrons
- No empty space!
- Others will be before and after you
 - Play nice

K500 & K150 BEAM SCHEDULES

		SEE LINE K500: Mode 1	Light Ion Guide K150: Mode 2	Triplet Line K500: Mode 2B K150: Mode 3B		Neutron Ball K500: Mode 6A, 6B K150: Mode 6		Beam Development
		MARS K500: Mode 2A K150: Mode 3A	SEE LINE K150: Mode 1	Irradiation Line K150: Mode 8	MDM K500: Mode 5A,5B K150: Mode 5	Aggie Line K500: Mode 7A, 7B K150: Mode 7		Maintenance
		Monday 13-May-19 D-LF N-JJ	Tuesday 14-May-19 D-LF N-JJ	Wednesday 15-May-19 D-LF N-JJ	Thursday 16-May-19 D-JP N-JC	Friday 17-May-19 D-JP N-JC	Saturday 18-May-19 D-JP N-JC	Sunday 19-May-19 D-JP N-JC
0000	K500	NAVSEA SEE Beams	↓	↓	↓	↓	↓	↓
0800		Quarterly Interlocks	Quarterly Interlocks	Quarterly Interlocks	↓	↓	Texas Instruments SEE Beams	NAVSEA SEE Beams
1600		Intersil SEE Beams	Reflex Photo SEE Beams	NASA JPL SEE Beams	↓	↓	JD Instruments SEE Beams	↓
0000	K150	↓	↓	↓	↓	↓	↓	↓
0800		Quarterly Interlocks	Quarterly Interlocks	Quarterly Interlocks	↓	↓	↓	↓
1600		Beam Development	Beam Development	Beam Development	↓	↓	↓	↓
		20-May-19 D-JP N-JC	21-May-19 D-JP N-JC	22-May-19 D-JP N-JC	23-May-19 D-JJ N-LF	24-May-19 D-JJ N-LF	25-May-19 D-JJ N-LF	26-May-19 D-JJ N-LF
0000	K500	NAVSEA Cont.	↓	↓	↓	↓	↓	↓
0800		↓	Christian 30-40 MeV/u ¹³ C	↓	↓	↓	↓	↓
1600		↓	↓	↓	↓	↓	↓	↓
0000	K150	Beam Development	↓	↓	↓	↓	↓	↓
0800		↓	↓	↓	↓	↓	↓	↓
1600		↓	↓	↓	↓	↓	↓	↓
		27-May-19 D-JJ N-LF	28-May-19 D-JJ N-LF	29-May-19 D-JJ N-LF	30-May-19 D-JC N-JP	31-May-19 D-JC N-JP	1-Jun-19 D-JC N-JP	2-Jun-19 D-JC N-JP
0000	K500	Christian Cont.	↓	↓	↓	↓	↓	↓
0800		↓	↓	RTS SEE Beams	Texas Instruments SEE Beams	Boeing R&T SEE Beams	↓	↓
1600		↓	↓	Rugged SEE Beams	Astranis SEE Beams	↓	Sandia SEE Beams	↓
0000	K150	Beam Development	↓	↓	↓	↓	↓	↓
0800		Beam Development	CMF Group 6.3 MeV/u ⁴⁰ Ar	↓	↓	↓	Beam Development	↓
1600		↓	↓	↓	↓	↓	↓	↓

Before you go

- Make travel plans
 - Allow time for setup and training
 - Be rested and ready for beam start
- Test development
 - Test boards, monitoring equipment
 - Test, test, test!!! – long cables, full setup
 - Bring spares – *your tested setup won't work in field*
 - *No kidding – your tested setup won't work in field*
- Packing
 - Bring everything!
 - Appropriate clothes – bring a jacket
 - Cables, tools, connectors, power cords, tape
 - **Do not expect facility to provide anything**
- Shipping equipment
 - Overnight shipping isn't – allow time
 - Anything expensive will break – or turn up in Antarctica
 - Storage at facility



Labeled parts prevent broken hearts
- Dr. Elizabeth Auden



On arrival

- Find the nearest FedEx and hardware store
- Walk through the facility
 - Where will cables go?
 - Test board mounting fixtures
 - User / setup areas
- Find your stuff
 - May be locked in a receiving area
 - Open boxes, check for obvious damage
- Setup test in staging area
 - Verify every test setup with full cables
 - Verify every part still works
- Take a break
 - Have dinner, go over test plan
 - Don't stay at facility all night trying to debug something

Beam Setup

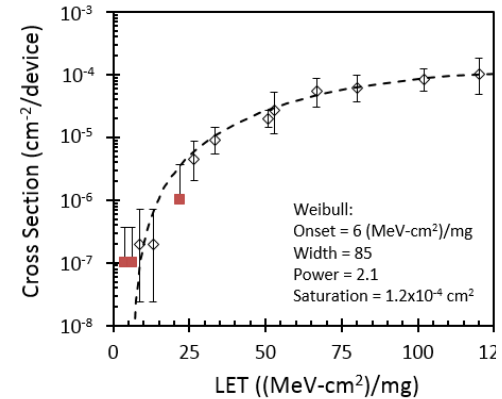
- Confirm beam plan with operators
 - What to start with, flux, beam diameter
- Move from staging into experimental area
 - Cable routes, should have had long cables connected already
 - Mount test board in beam
- Tune beam into cave
 - Gets beam from accelerator to your board
 - No access to experiment
 - High flux – block or remove test board
- Dosimetry checks
 - Calibrate dosimetry
 - voltage/thresholds, spatial uniformity, etc.
- Put test board back into beam

First beam on target – finally!

- First chance to see if guesses were right
 - Flux, fluence, error rate
 - Are types of errors expected and reasonable?
 - Cross section reasonable?
- Verifies that test setup is working correctly
 - Do you see events?
 - Are they being recorded correctly?
 - Scope display scale, auto-save, disk files usable and not over-writing

Start the test

- Time management
 - Clear goals for what needs to be accomplished
 - Be flexible with the test plan – focus on overall goals
 - Characterize first part well, spot-check on following parts
- Plot as you go
 - Gives great insight for what to do next
 - Check coverage and consistency of results – even roughly
- Personnel management
 - Everyone wants to help setup, then sleepy at the same time
 - Plan access to regular meals, move around
 - Stress and anger management
- Respect other team members' tests in your beam block
- Respect testers that follow you
 - End with time to spare



End of beam

- Courtesy
 - Remove setup quickly - don't leave stuff in the way of the next group
- Activated items
 - Survey by facility staff – you don't get to decide
 - Activated items are not released, no matter how expensive or urgent
- Packing / Shipping
 - Back up data immediately!! Multiple copies & routes home best.
 - Collect facility logs as available, or make arrangements to get them
 - Facility will not pack. Don't assume storage or return shipping. Ask ahead of time!
- Clean up area
 - Remove trash – including leftover food
 - Make final storage/shipping arrangements
 - Turn in dosimetry, sign out of area as needed
- Go sleep!!!

Back home again

- Receive return shipment
 - Unpack and put away...
- Data analysis
 - Do it soon before you forget everything
 - Gather and archive all notes and logs
- Test reports
 - Get them done! Be complete!
 - A good report may be the only real reference document for later use
- Pay final invoice
 - *If you ever want to go there again, do it without delay*

Final thoughts

- Understand what you need to accomplish
 - Stick to your goals
- Be prepared
 - plan ahead, ask for help
- Expect disaster
 - Have a plan to deal with it
- Be kind to each other
 - Testing is hard. Be gentle.
- Have fun!

